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(54) (TITLE OF THE INVENTION) Wireless Communication Device

(57) (ABSTRACT)
(PURPOSE) To realize a smaller and thinner bi-directional wireless communication device to be used in a wireless LAN with the CSMA protocol.
(CONSTITUTION) The present invention is provided with a multiplier circuit 24 that is controlled by dynamic conditions at the time of transmission and that uses a non-linear element to generate a transmission local oscillation signal LOT; a VCO 21A that oscillates at a second local oscillation frequency, receives a transmission data DT at the time of transmission, conducts FSK modulation, and generates a transmission modulation signal L2T; and a transmission mixer 23 that is controlled by dynamic conditions at the time of transmission and that generates a transmission intermediate frequency signal IFT from the transmission local oscillation signal LOT and the transmission modulation signal L2T.

[see source for figure]

4. RF amplifier
5. Mixer
7. IF amplifier
8. SAW filter
9. IF amplifier
11. Mixer
13. IF amplifier
14. SAW filter
16. IF amplifier
17. Limiter
18. Demodulator circuit
19. Comparator
23. Mixer
24. Multiplier circuit
2[5]. Mixer
27. RF amplifier
29. Frequency synthesizer
30. Frequency synthesizer
31. Oscillation circuit
100A. Common transmitting and receiving section
200A. Receiving section
300A. Transmitting section

(SCOPE OF PATENT CLAIMS)

(CLAIM 1) A carrier sense bi-directional wireless communication device that is provided with a first receiving mixer that receives a received signal and a first local oscillation signal with a first frequency that corresponds to a selected channel that is selected from a plurality of communication channels that have the same transmission and receiving frequency and that divide a previously determined frequency band and that generates a primary intermediate frequency signal with a second frequency; a second receiving mixer that receives said primary intermediate frequency and a second local oscillation signal with a third frequency and that generates a secondary intermediate frequency with a fourth frequency; a first local oscillation circuit that generates said primary intermediate frequency signal; a second local oscillation circuit that generates said secondary intermediate frequency; and a reference frequency signal oscillation circuit that generates a reference frequency signal that is provided to said first and second local oscillation circuits; and that confirms that said selected channel is an idle channel that does not contain transmission signals from a remote station before it starts transmission and then transmits its transmission signal; that is

a wireless communication device characterized in that it is provided with a multiplier circuit that uses a non-linear element and that is controlled by dynamic conditions at a first level corresponding to transmission of a transmission and receiving switching signal, that multiplies said reference frequency signal by a previously determined multiplier, and that generates a transmission local oscillation signal at said fourth frequency;

a modulation oscillation circuit that oscillates at said third frequency, receives said transmission signal at the time of transmission, conducts said modulation, and generates a transmission modulation signal;

and a second transmission mixer that is controlled by dynamic conditions at said first level of said transmission and receiving switching signal, that receives said transmission local oscillation signal and said transmission modulation signal, and that generates said transmission intermediate frequency signal.

(CLAIM 2) A wireless communication device according to Claim 1 characterized in that said modulation oscillation circuit shares the functions of said second local oscillation circuit that supplies said second local oscillation signal at the time of reception.

(CLAIM 3) A wireless communication device according to Claim 1 characterized by having a first and second voltage control oscillation circuits controlled by a first and second synthesizer that include a phase locked loop circuit where each of said first local oscillation circuit and said modulation oscillation circuit operate on the basis of said reference frequency signal, respectively.

(CLAIM 4) A wireless communication device according to Claim 1 characterized in that it is provided with a first switching circuit that switches in response to the first and second level of said transmission and receiving switching signal to provide said transmission modulation signal to said second transmission mixer and to provide said second local oscillation signal to said second receiving mixer respectively;

a second switching circuit that selects one of said transmission modulation signal and said primary intermediate frequency signal in response to said first and second level respectively and supplies it to a primary intermediate frequency amplifier circuit;

a third switching circuit that supplies the output signal from said primary intermediate frequency amplifier circuit to one of said first transmission mixer and said second receiving mixer in response to said first and second level respectively;

a fourth switching circuit that selects one of said second receiving mixer signal and said transmission local oscillation signal in response to said first and second level respectively and supplies it to a first secondary intermediate frequency amplifier circuit; and

a fifth switching circuit that supplies the output signal of a band-pass filter on said secondary intermediate frequency signal to one of said second transmission mixer and a second secondary intermediate frequency amplifier circuit in response to the first and second level, respectively.

(DETAILED DESCRIPTION OF THE INVENTION)

(0001)

(FIELD OF INDUSTRIAL APPLICATION) The present invention relates to a wireless communication device, specifically a bi-directional wireless communication device used for a wireless LAN (Local Area Network) using the CSMA (Carrier Sense Multiple Access) protocol.

(0002)

(PRIOR ART) Development of the latest wireless technology is remarkable and the transformation to wireless is progressing through the use of high frequency bands, such as the microwave bands used in wireless LANs, in fields such as high-speed data transmission that are conventionally conducted using cables as a transmission medium.

(0003) A LAN is a network which mutually connects device consisting of a plurality of independent computers. It is closed and exists in a limited area controlled by the users themselves, such as inside a single building or structure. An example of the LAN is a system wherein a comparatively high-performance computer called the "server" connects a plurality of personal computers called "clients" via data communication lines and allows data bases to be shared and data to be exchanged among the individual personal computers. This sort of LAN has become commonplace as high-performance personal computers have proliferated and is also known by the term "computer downsizing."

(0004) A wireless LAN performs the data communication in this sort of LAN by wireless communication, and since installation of the cables for data transmission is unnecessary, it has the advantage that construction at installation is simple and extension and layout modification after installation are very easy.

(0005) Moreover, as miniaturization of the personal computers used as terminals progresses, but sharing and data processing of a database become possible, even for mobile devices, and future development is highly anticipated. For this reason, it cannot be overemphasized that miniaturization and lowered costs of the wireless receiver-transmitters for data communication must accompany the miniaturization of computers.

(0006) Although a number of methods have been proposed as protocols for the wireless data transmission in this sort of wireless LAN, the most promising of these use microwave bands, such as a 2-3 GHz band, and spectrum diffusion techniques, especially frequency hopping methods.

(0007) An example of this conventional kind of wireless communication device is the system established by the American IEEE 802.11 committee that provides 100 channels with a bandwidth of 1 MHz in a 100 MHz band of the 2.4–2.5 GHz band, that uses frequency hopping, and that provides a data transfer rate of about 1 Mbps using FSK modulation.

(0008) For the communication multiplexing system, the CSMA protocol is used. The CSMA protocol is a system that prevents the collision of transmissions from two or more terminal stations. Before the start of transmission by the various terminal stations that are servers or clients, the CSMA protocol conducts a carrier sense operation to determine whether there is radiation from a terminal station other than the carrier on the radio wave, that is, on the frequency channel on which reception will be attempted, and immediately after confirming that there is no radiation on said carrier, it begins transmission on said frequency channel.

(0009) With reference to Figure 2, which shows the conventional wireless communication devices used as terminal stations in this type of wireless LAN system as a block, the conventional wireless communication device is provided with a common transmitting and receiving section 100 which is a common section that includes an antenna to be used for both transmitting and receiving, a standard transmission source, etc., a receiving section 200 that amplifies and demodulates received signals and outputs a received data DR, and a transmitting section 300 that receives a transmission data DT, modulates it, converts its frequency, and amplifies it, and outputs transmission signals on a predetermined transmission frequency.

(0010) The common transmitting and receiving section 100 is provided with an antenna 1 that is used for both transmitting and receiving, a band pass filter (BPF) 2 that is connected to the antenna 1 and that passes only signals in the predetermined 2.4–2.5 GHz frequency band corresponding to the transmitting and receiving channels, an antenna switching circuit (ASW) 3 which connects the BPF 2 to the receiving section 200 at the time of carrier sensing and reception, and connects [the BPF 2] to the transmitting section 300 at the time of transmission, respectively, an oscillation circuit 31 which contains crystal oscillation circuits with temperature compensation that supply a reference frequency signal FR to synthesizers 30, 29, and 33 for local oscillation in the receiving section 200 and the transmitting section 300, a voltage controlled oscillation circuit (VCO) 28 which supplies a first local oscillation signal LO1, and a synthesizer 30 which receives a reference signal FR and controls a VCO 21.

(0011) The receiving section 200 is a double super heterodyne method and is provided with an RF amplifier 4 which carries out low noise magnification of the input signal R which is supplied from the ASW 3, a mixer 5 which receives the first local oscillation signal LO1 and converts the output signal of an RF amplifier 4 into a first IF signal, IF amplifiers 7 and 9 which amplify the first IF signal, a SAW filter 8 which is the band pass filter from which has a predetermined band property and which removes spurious signals, such as image signals, a mixer 11 which receives the second local oscillation signal LO2 and converts the output signal of an IF amplifier 9 into a second IF signal, IF amplifiers 13 and 16 which amplify the second IF signal, a SAW filter 14 which is the band pass filter for the second IF, which has a predetermined band property, and which removes spurious signals, such as image signals, a limiter 17 which performs amplitude limiting on the output signal of the IF amplifier 16, a demodulator circuit 18 which demodulates the output signal of the limiter 17 and outputs the demodulated signal, a comparator 19 which shapes the waveform of the demodulated signal and outputs a received data DR, a receiving signal strength display circuit 20 (RSSI) which outputs a signal RS with which supply of the output S of IF amplifier 16 is received, and the receiving signal strength corresponding to the amplitude of this output S is expressed, an armature-voltage control oscillation circuit (VCO) 21 which supplies the second local oscillation signal LO2, and a synthesizer 29 which receives supply of a reference signal FR and controls VCO 21.

(0012) The transmitting section 300 is provided with a VCO 32 which supplies a transmission IF signal IFT that is FSK modulated in response to received transmission data DT, a synthesizer 33 which receives a reference signal FR and controls a VCO 32, a mixer 25 which receives the transmission IF signal IFT and the first local signal and converts the transmission IF signal IFT into a converted signal TS of a predetermined frequency, a BPF 26 which removes spurious signals, such as image signals, from the converted signal TS, and an RF power amplification 27 which carries out power amplification of the converted signal TS, and outputs a transmission signal T.

(0013) In order to simplify the explanation, general values have been set for the major signal frequencies are as follows: for the reception and transmission frequency FRT for each channel, 2.4–2.5 GHz; for the channel interval, 1 MHz; for the first IF frequency and the transmission IF frequency, 400 MHz; for the second IF frequency, 40 MHz; for the first local oscillation frequency LO1 (FRT minus 400 MHz) = 2.0–2.4 GHz; for the second local oscillation frequency LO2, 360 MHz, for the reference frequency FR 10 MHz, respectively.

(0014) Next, operation is explained with reference to Figure 2. First, in the receive state, an input signal R with a frequency corresponding to desired channel of 2.4–2.5 GHz frequency band is extracted by BPF 2 from the received signal received by the antenna 1 and is supplied via ASW 3 to RF amplifier 4, where it is amplified. The output signal of the RF amplifier 4 is supplied to the mixer 5, and the mixer 5 generates the first 400 MHz IF signal I1 in response to the magnification input signal and the first local oscillation signal LO1 of the frequency corresponding to the set channel of the 2.0–2.4 GHz band from the VCO 28. For example, if the above-mentioned set channel frequency is set to 2.45 GHz, the frequency of the signal LO1 will be set to 2.05 GHz. A signal I1 is amplified by the IF amplifier 7, spurious signals are removed by the SAW filter 8, and the signal is further amplified by the IF amplifier 9 and is supplied to the mixer 11 as a signal I1A. The mixer 11 generates a second 40 MHz IF signal I2 in response to the second local oscillation signal LO2 with a frequency of 360 MHz from the signal I1A and the VCO 21. A signal I2 is amplified by the IF amplifier 13, spurious signals are removed by the SAW filter 14, and the signal is further amplified by the IF amplifier 16, and it is supplied to the limiter 17 as a signal I2A and to the RSSI 20 as a signal S, respectively. The limiter 17 receives the signal I2A and

supplies a signal IL which is generated by performing predetermined amplitude limiting on the signal I2A to the demodulator circuit 18. The demodulator circuit 18 demodulates Signal IL and supplies the demodulated signal to the comparator 19. The comparator 19 shapes the demodulated signal and generates and outputs the received data DR as digital data signals. On the other hand, the RSSI 20 responds to the supplied signal S and outputs a signal RS corresponding to the amplitude of the signal S, i.e., receiving signal strength, and supplies it to an external control system. Moreover, the signal RS is used also for checking for the existence of transmissions from other terminal stations in the set channel.

(0015) The frequency synthesizer 30 includes a frequency divider which is a prescaler which divides the first local oscillation signal LO1 by the division ratio corresponding to the set channel and generates a divided signal of about 10 MHz and a phase-locked loop (PLL) circuit which performs phase comparison of the divided signal and the reference frequency signal FR, responds to any phase error, and generates a control signal for the VCO 28. The frequency synthesizer 30 receives the 10 MHz reference frequency signal FR from the oscillation circuit 31 and controls the VCO 28 to perform a phase simulation operation with this as the reference frequency and to generate the first local oscillation signal LO1 of the frequency corresponding to the set channel.

(0016) Next, in the transmission state, a transmission data DT is supplied to the VCO 32. The oscillation frequency of the VCO 32 is 400 MHz, the frequency of the transmission IF signal IFT, and it is controlled by the control signal PT of the frequency synthesizer 33 on the basis of the frequency of 10 MHz of the reference frequency signal FR. The VCO 32 responds to the supply of the transmission data DT, performs a frequency shift corresponding to the sign value of transmission data DT for this oscillation frequency corresponding to the control signal PT, and generates the transmission IF signal IFT upon which FSK modulation has been carried out. The transmission IF signal is supplied to the mixer 25. The mixer 25 responds to the supply of the transmission IF signal IFT and the first local oscillation signal LO1, converts them into the converted signal TS of the set channel frequency, and supplies it to the RF power amplifier 27 via the BPF 26 for spurious signal removal. The RF power amplifier 27 carries out power amplification of the converted signal TS, generates a transmission signal T, supplies it to the antenna 1 via the ASW 3 and the BPF 2, and sends out the transmission signal T as an electric wave.

(0017) Selection of the channel to be used is performed by the frequency synthesizer 30 of the common transmitting and receiving section 100 by setting the oscillation frequency of the VCO 28, i.e., the frequency of the first local oscillation signal LO1. As mentioned above, each terminal station must check that the channel chosen in the carrier sense state before starting transmission is vacant, i.e., other terminal stations have not transmitted using the channel. Therefore, it must first place itself in the receive state with respect to the above-mentioned channel and must be placed in the transmission state instantaneously after confirming that the channel is an idle channel with reference to the output signal RC of the RSSI 20. Although this amount of time need only be sufficient to collision with other terminal stations, an actual system requires 10 μs or less as a duration from the receive state to the start of transmission from the following basis.

(0018) As described above, the desired value of said required time in the wireless LAN using this frequency-hopping method and said required time in a wireless LAN using the direct diffusion method with a comparable data transmission rate is prescribed to be 10 μs or less in document IEEE 802.11-93/232rl of the U.S. IEEE 802.11 committee published in January 1994.

(0019) On the other hand, the time required for stabilization of the frequency, i.e., the lock time, corresponding to the channel setting resulting from the combination of the frequency synthesizers 30, 29, and 33 used in the PLL circuits and the VCO 28, 21, and 32 is set to at least several tens of microseconds based on the response time of the internal reference frequency of this type of general PLL and the time constant correspondence of the loop filter.

(0020) That is, said PLL circuit lock time becomes shorter as the internal reference frequency generated by dividing from the reference frequency signal FR becomes higher or as the cut-off frequency of the loop filter becomes higher. In this example, in order to set up channels in the 2.4–2.5 GHz band at intervals of 1 MHz, a prescaler must use 2 modulus form of 64/65 division, and even if it uses 50 MHz, which is the practical upper limit of current technology as a clock frequency, 500 kHz of the above-mentioned internal reference frequency is an upper limit. Moreover, the cut-off frequency of the above-mentioned loop filter must set up an optimum value in consideration of a carrier noise ratio.

(0021) For this reason, after the check for an idle channel in the receive state, in order to start transmission using that channel at high speed, the frequency of the first local oscillation signal LO1 must be the same in transmission and reception, and accordingly, the frequency of the first IF signal IF1 in reception and the IF signal IFT in transmission must be the same 400 MHz, and also the VCO 32 of the transmitting section 300 must always oscillate during the time of the receive state.

(0022)

(Problem to be Solved by the Invention) In the conventional wireless communication device described above, since the primary intermediate frequency in reception and the intermediate frequency in transmission are the same, and since it must be prepared to start high speed transmission in the carrier sense state that precedes transmission, the VCO that supplies the transmission intermediate frequency signal must always be in the oscillation state. Therefore, in order to prevent the idle selected channel from be considered in use as the result of a malfunction of the receiving signal strength display circuit due to interference to the receiving section by radiation leakage signal from said VCO and the start of transmission becoming impossible, it being necessary to consider a construction which carries out electric shielding and strict separation of the transmitting section and receiving sections and it has been very difficult to make thinner and smaller device, for example, credit-card-sized device.

(0023)

(Means for Solving the Problem) The wireless communication device according to the present invention is a carrier sense bi-directional wireless communication device

that is provided with a first receiving mixer that receives a received signal and a first local oscillation signal with a first frequency that corresponds to a selected channel that is selected from a plurality of communication channels that have the same transmission and receiving frequency and that divide a previously determined frequency band and that generates a primary intermediate frequency signal with a second frequency; a second receiving mixer that receives said primary intermediate frequency and a second local oscillation signal with a third frequency and that generates a secondary intermediate frequency with a fourth frequency; a first local oscillation circuit that generates said primary intermediate frequency signal; a second local oscillation circuit that generates said secondary intermediate frequency; and a reference frequency signal oscillation circuit that generates a reference frequency signal that is provided to said first and second local oscillation circuits; and that confirms that said selected channel is an idle channel that does not contain transmission signals from a remote station before it starts transmission and then transmits its transmission signal; characterized in that it is provided with a multiplier circuit that uses a non-linear element and that is controlled by dynamic conditions at a first level corresponding to transmission of a transmission and receiving switching signal, that multiplies said reference frequency signal by a previously determined multiplier, and that generates a transmission local oscillation signal at said fourth frequency; a modulation oscillation circuit that oscillates at said third frequency, receives said transmission signal at the time of transmission, conducts said modulation, and generates a transmission modulation signal; and a second transmission mixer that is controlled by dynamic conditions at said first level of said transmission and receiving switching signal, that receives said transmission local oscillation signal and said transmission modulation signal, and that generates said transmission intermediate frequency signal.

(0024)

(EXAMPLE) Next, Figure 1 shows an example of a wireless communication device according to the present invention wherein the configuration elements common to Figure 2 have the same common reference letters and numbers with blocks that are similarly referred to. The wireless communication device of the example shown in this drawing is equipped with a common transmitting and receiving section 100A which has the respectively same function as usual, a receiving section 200A, and a transmitting section 300A instead of the common transmitting and receiving section 100, the conventional receiving section 200, and the conventional transmitting section 300, respectively.

(0025) A common transmitting and receiving section 100A is equipped with, in addition to a common antenna 1, a band pass filter (BPF) 2, an antenna switching circuit (ASW) 3, an oscillation circuit 31, a voltage controlled oscillation circuit (VCO) 28, and a synthesizer 30 that are common with the conventional type, a multiplier circuit 24 that uses a nonlinear circuit element that operates at a level corresponding to the transmission state of transmission and receiving switching signal CT, that carries out 4× multiplication of the reference frequency signal FR, and that generates a 40 MHz transmission local oscillation signal LOT.

(0026) The receiving section 200A is provided with, in addition to common mixers 5 and 11, IF amplifiers 7, 9, 13, and 16, SAW filters 8 and 14, a limiter 17, a demodulator circuit 18, a comparator 19, a receiving signal strength display circuit (RSSI) 20, and a synthesizer 29 that are common with the conventional type, a VCO 21A which replaces the VCO 21 and which conducts frequency shifting according to the code value of a transmission data DT received during transmission and that generates an FSK modulated transmission local oscillation signal / second local oscillation signal L2T / LO2, a switching circuit (SW) 22 which switches the transmission local oscillation signal / second local oscillation signal L2T / LO2 to the reception RX side or the transmission TX side according to the state of reception and transmission, a mixer 23 which operates at a level corresponding to the transmission state of transmission and receiving switching signal CT and which generates a transmission IF signal IFT from the filtered transmission local oscillation signal LOX from which spurious signals have been removed and the first local oscillation signal LO1 from the SW 22, a SW 6 which is inserted between a mixer 5 and an IF amplifier 7 and which switches between the signal IFT and the first IF signal IF1 and supplies them to an IF amplifier 8, a SW 10 which is inserted between an IF amplifier 9 and a mixer 11 and which switches the output signal of IF amplifier 9 to one of a mixer 11 and a mixer 25, a SW 12 which is inserted between a mixer 11 and an IF amplifier 13 and switches between the second IF signal from the mixer 11 and the transmission local oscillation signal LOT and supplies them to the IF amplifier 13, and a SW 15 which is inserted between a SAW filter 14 and an IF amplifier 16 and which switches between the output signal of the SAW filter 14 to the IF amplifier 16 or the mixer 23. Each of the SW 22, 6, 10, 12, and 15 responds to the level L and H corresponding to the reception and the transmission state of the transmitting and receiving change signal CT, respectively, and performs switching operations.

(0027) The conventional VCO 32 and the conventional frequency synthesizer 33 have been eliminated, so the transmitting section 300A is equipped with a mixer 25, a BPF 26, and a RF power amplifier 27 that are common with the conventional type.

(0028) As in the conventional, the major signal frequencies are as follows: for the reception and transmission frequency FRT for each channel, 2.4–2.5 GHz; for the channel interval, 1 MHz; for the first IF frequency and the transmission IF frequency, 400 MHz; for the second IF frequency, 40 MHz; for the first local oscillation frequency LO1 (FRT minus 400 MHz) = 2.0–2.4 GHz; for the second local oscillation frequency LO2, 360 MHz, for the reference frequency FR 10 MHz, respectively.

(0029) Next, the operation of this example is explained with reference to Figure 1. First, in the receive state, each of the SW 22, 6, 10, 12, and 15 are set to the reception RX side according to the L level of the transmitting and receiving change signal CT. In addition, the mixer 23 and the multiplier circuit 24 are set in a non-operational state. These established states are the same as those in the case of the receive state of the conventional wireless communication device mentioned above, and therefore, the operation of each portion of the receiving section is also completely the same. However, since the multiplier circuit 24 and the mixer 23 are in a non-operational state, a transmission IF signal IFT with the same frequency as the first IF signal

IF1 does not exist and cannot generate interference with receiving section 200A. Therefore, in the receive state prior to transmission initiation, i.e., the carrier sense state, positive operation of the RSSI 20 is possible and the receiving signal strength signal RS is generated according to whether the selected channel is idle or in use. When the above-mentioned selected channel is idle, in response to the signal RS corresponding to an idle channel, an external control system (omitted from the illustration) immediately sets the transmitting and receiving change signal CT at the H level of corresponding to the transmission state.

(0030) Next, in the send state, in response to the H level of the transmitting and receiving change signal CT, each of the SW 22, 6, 10, 12, and 15 is set to the transmission TX side. In addition, the mixer 23 and the multiplier circuit 24 are set in the operating state by ON control of the power source in response to the H level of the transmitting and receiving change signal CT, etc. Thereby, the multiplier circuit 24 multiplies the 10 MHz reference frequency signal FR from the oscillation circuit 31 is multiplied by 4 and generates the 40 MHz transmission local oscillation signal LOT. The multiplier circuit 24 is provided with of well-known circuits which conduct pulse drive of nonlinear circuit elements such as logic gate circuits and step recovery diodes. The signal LOT is supplied to the SAW filter 15 via the SW 12 and the IF amplifier 13 and is supplied to one input of the mixer 23 via the SW 15 as the filtered transmission local oscillation signal LOX from which spurious signal components have been removed.

(0031) On the other hand, the transmission data DT is supplied to the VCO 21A. The oscillation frequency of the VCO 21A is 360 MHz of the second local oscillation signal LO2 and is controlled by the control signal QT of the frequency synthesizer 29 on the basis of the frequency of the 10 MHz reference frequency signal FR. The VCO 21A responds to the supply of the transmission data DT and performs a frequency shift corresponding to the sign value of transmission data DT for this oscillation frequency corresponding to control signal QT and generates the transmission second local oscillation signal L2T that has been FSK modulated. The signal L2T is supplied to the input of the other side of the mixer 23 via the SW 22. The mixer 23 responds to the signal LOX and the supply of the signal L2T, generates the 400 MHz transmission IF signal IFT, and supplies it to the SAW filter 8 via the SW 6 and the IF amplifier 7. The SAW filter 8 removes spurious signal components from the signal IFT and supplies it to one input of the mixer 25 via the IF amplifier 9 and the SW 10 as the filtered transmission IF signal ITX.

(0032) The mixer 25 responds to the supply of the filtered transmission IF signal ITX and the first local oscillation signal LO1, and as in the conventional, converts them into the signal TS of the set channel frequency and it to the RF power amplifier 27 via the BPF 26. The RF power amplifier 27 carries out power amplification of the converted signal TS, generates the transmission signal T, supplies it to the antenna 1 via the ASW 3 and the BPF 2, and sends out the transmission signal T as an electric wave.

(0033) Since each of the VCO 31, 28, and 21 is always in an oscillation state for the frequency corresponding to the selected channel even in the above-mentioned carrier sense and receive states and since each of the multiplier circuit 24 and the mixer 23 do not include any special time constant circuits such synthesizers, etc., typically starts within 1 μs from an operating state setup when the power source is turned on, satisfying the reception/transmission changeover duration for 10 μs or less is easy.

(0034) As mentioned above, since theoretically interference to the receiving system by the transmitting system signal in the carrier sense and receive states does not exist, electric shielding between the transmitting system and the receiving system can be simplified, and a high level integration is possible by forming both of them on the same semiconductor chip. A smaller and thinner appearance is attained by this and dimensions can be reduced to about 85.6 mm × 54 mm × 5 mm, the so-called credit card size.

(0035) Although an example of embodiment of the present invention was explained above, various forms are possible for the present invention and it is not restricted to the above-mentioned example of embodiment. For example, using an independent band-pass filter instead of using the SAW filter in the receiving section to remove spurious components unless from the transmission signal and elimination of the related switching circuits is applicable, provided, of course, that it does not deviate from the major points of the present invention.

(0036)

(EFFECT OF THE INVENTION) As explained above, the wireless communication device according to the present invention is provided with a multiplier circuit which is controlled by the operating state at the time of transmission, and which generates a transmission local oscillation signal using a nonlinear component, a modulation oscillation circuit with a second local oscillation frequency, and a second mixer for transmission which is controlled by the operating state at the time of transmission and which generates a transmission intermediate frequency signal from a transmission local oscillation signal and a transmission modulating signal, and since interference to the receiving system by the transmitting system signal in the carrier sense and receive states does not exist theoretically, electric shielding between the transmitting system and the receiving system can be simplified and high integration by formation of both on the same semiconductor chip is also attained, it is effective in attaining the smaller and thinner appearance of the credit card size and in securing high-speed transmission initiation from the carrier sense condition.

(BRIEF DESCRIPTION OF THE DRAWINGS)

(FIGURE 1) This is the block diagram showing one example of the wireless communication device according to the invention.

(FIGURE 2) This is the block diagram showing an example of the conventional wireless communication device.

(LEGEND)

1	Antenna
2, 26	BPF
3	ASW
4	RF Amplifier
5, 11, 23, 25	Mixer
6, 10, 12, 15, 22	SW
7, 9, 13, 16	IF amplifier
8, 14	SAW filter
17	Limiter
18	Demodulator circuit
19	Comparator
20	RSSI

21, 28, 32, 21A	VCO
27	RF Power amplifier
29, 30, 33	Frequency synthesizer
30	Frequency synthesizer
31	Oscillation circuit
100, 100A	Common transmitting and receiving section
200, 200	Receiving section
300, 300A	Transmitting section

(FIGURE 1)

[see source for figure]

4. RF amplifier
5. Mixer
7. IF amplifier
8. SAW filter
9. IF amplifier
11. Mixer
13. IF amplifier
14. SAW filter
16. IF amplifier
17. Limiter
18. Demodulator circuit
19. Comparator
23. Mixer
24. Multiplier circuit
2[5]. Mixer
27. RF amplifier
29. Frequency synthesizer
30. Frequency synthesizer
31. Oscillation circuit
100A. Common transmitting and receiving section
200A. Receiving section
300A. Transmitting section

(FIGURE 2)

[see source for figure]

4. RF amplifier
5. Mixer
7. IF amplifier
8. SAW filter
9. IF amplifier
10. Mixer
13. IF amplifier
14. SAW filter
16. IF amplifier
17. Limiter
18. Demodulator circuit
19. Comparator
25. Mixer
27. RF amplifier
29. Frequency synthesizer
30. Frequency synthesizer
31. Oscillation circuit
33. Frequency synthesizer
100. Common transmitting and receiving section
200. Receiving section
300. Transmitting section

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平7－283810

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Ｈ０４Ｌ　12/28				
			Ｈ０４Ｌ　11/00　　３１０　Ｂ	

審査請求　有　請求項の数４　ＯＬ　（全７頁）

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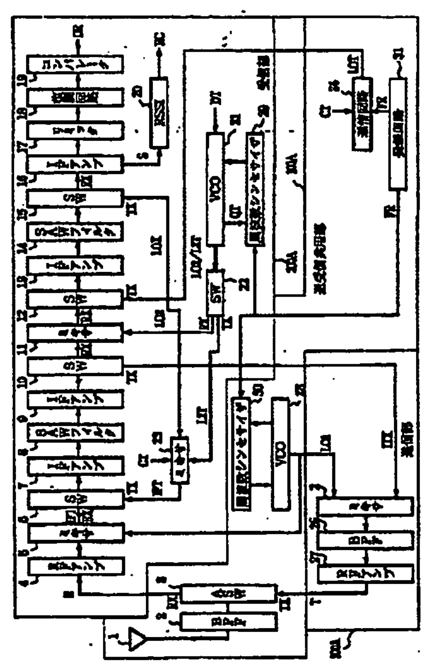
(54)【発明の名称】　無線通信装置

(57)【要約】

【目的】ＣＳＭＡ方式によるワイアレスＬＡＮに用いる双方向の無線通信装置の小型化・薄型化を実現する。

【構成】送信時に動作状態に制御され非直線素子を用い送信局部発振信号ＬＯＴを発生する逓倍回路２４と、第２局部発振周波数で発振し送信時に送信データＤＴの供給を受けＦＳＫ変調を行い送信変調信号Ｌ２Ｔを生成するＶＣＯ２１Ａと、送信時に動作状態に制御され送信局部発振信号ＬＯＴと送信変調信号Ｌ２Ｔとから送信中間周波信号ＩＦＴを生成する送信用のミキサ２３とを備える。



【特許請求の範囲】

【請求項1】　受信信号と予め定めた周波数帯域を分割した送受信周波数が同一の複数の通信チャネルの任意の選択した1つのチャネルである選択チャネル周波数対応の第1の周波数の第1の局部発振信号との供給を受け第2の周波数の第1中間周波信号を生成する第1の受信用ミキサと、前記第1中間周波信号と第3の周波数の第2の局部発振信号との供給を受け第4の周波数の第2中間周波信号を生成する第2の受信用ミキサと、前記第1の局部発振信号を発生する第1の局部発振回路と、前記第2の局部発振信号を発生する第2の局部発振回路と、前記第1および第2の局部発振回路に供給する基準周波数信号を発生する基準周波数信号発振回路と、送信データによる所定の変調を受けた前記第2の周波数の送信中間周波信号と前記第1の局部発振信号との供給を受け前記選択チャネル周波数の送信信号を生成する第1の送信用ミキサとを備え、前記選択チャネルが他局の送信信号が存在しない空チャネルであることを送信開始前に確認して自局の送信信号を発射するキャリアセンス多重方式の無線通信装置において、

非直線素子を用い送受信切替信号の送信対応の第1のレベルで動作状態に制御され前記基準周波数信号を予め定めた逓倍数で逓倍し前記第4の周波数の送信局部発振信号を発生する逓倍回路と、

前記第3の周波数で発振し送信時に前記送信データの供給を受け前記変調を行い送信変調信号を生成する変調発振回路と、

前記送受信切替信号の前記第1のレベルで動作状態に制御され前記送信局部発振信号と前記送信変調信号との供給を受け前記送信中間周波信号を生成する第2の送信用ミキサとを備えることを特徴とする無線通信装置。

【請求項2】　前記変調発振回路が受信時に前記第2の局部発振信号を供給する前記第2の局部発振回路の機能を共有することを特徴とする請求項1記載の無線通信装置。

【請求項3】　前記第1の局部発振回路および前記変調発振回路の各々が前記基準周波数信号を基準として動作する位相ロックループ回路を含む第1および第2のシンセサイザによりそれぞれ制御される第1および第2の電圧制御発振回路を備えることを特徴とする請求項1記載の無線通信装置。

【請求項4】　前記送受信切替信号の第1および第2のレベルにそれぞれ応答して前記送信変調信号を前記第2の送信用ミキサに前記第2の局部発振信号を前記第2の受信用ミキサにそれぞれ供給するように切替る第1のスイッチ回路と、

前記第1および第2のレベルにそれぞれ応答して前記送信変調信号および前記第1中間周波信号のいずれか一方を選択して第1中間周波増幅回路に供給する第2のスイッチ回路と、

前記第1および第2のレベルにそれぞれ応答して前記第1中間周波増幅回路の出力信号を前記第1の送信用ミキサおよび前記第2の受信用ミキサのいずれか一方に供給する第3のスイッチ回路と、

前記第1および第2のレベルにそれぞれ応答して前記第2の受信ミキサおよび前記送信局部発振信号のいずれか一方を選択して第1の第2中間周波増幅回路に供給する第4のスイッチ回路と、

前記第1および第2のレベルにそれぞれ応答して前記第2中間周波信号用のバンドパスフィルタの出力信号を前記第2の送信用ミキサおよび第2の第2中間周波増幅回路のいずれか一方に供給する第5のスイッチ回路とを備えることを特徴とする請求項1記載の無線通信装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は無線通信装置に関し、特にCSMA（Carrier SenseMultiple Access）方式によるワイアレスLAN（LocalArea Network）に用いる双方向の無線通信装置に関する。

【0002】

【従来の技術】最近の無線通信技術の発達は目覚ましく、従来、伝送媒体として専らケーブルを用いて行われていた高速データ通信のような分野においても、ワイアレスLANのようにマイクロ波帯などの高い周波数帯を利用することにより無線化が進みつつある。

【0003】LANとは、複数の独立したコンピュータを含む装置を相互に接続するネットワークであり、一つのビル内や構内など利用者みずからが管轄する限られた地域に閉じて存在する。このLANの一例としては、「サーバ」となる比較的高性能のコンピュータと「クライアント」となる複数のパーソナルコンピュータをデータ通信回線で結び、データベースの共有化や各パーソナルコンピュータ間のデーターの授受を行うものがある。この種のLANはパーソナルコンピュータの高性能化に促されて普及しつつあり、「コンピュータのダウンサイジング化」という言葉によってもよく知られている。

【0004】ワイヤレスLANとは、このLANにおけるデータ通信を無線によって行うものであり、データ伝送用のケーブル設置が不用であるため、導入時の工事が簡単であり、また導入後の増設やレイアウト変更が極めて容易であるという利点がある。

【0005】また端末となるパーソナルコンピュータの小型化が進展すれば、移動しながらでもデータベースの共有化やデータ処理が可能となり、今後の発展が大いに期待されている。そのためには、コンピュータの小型化と共に、データ通信用の無線送受信機の小型化と低価格化が必要なのはいうまでもない。

【0006】このワイアレスLANの無線データ通信の方式には幾種類かの方式が提案されているが、その中で

は2～3GHz帯などのマイクロ波帯を用い、スペクトラム拡散技術、特に周波数ホッピング方式を利用する方式が有望視されている。

【0007】従来のこの種の無線通信装置の例としては、米国のIEEE802．11委員会で方式規格を検討中の、2．4～2．5GHz帯の100MHzの帯域において帯域1MHzの100チャネルが設定され、周波数ホッピング方式を用い、データをFSK変調して送受信を行う伝送レート1Mbps程度のシステムがある。

【0008】通信多重化方式はCSMA方式を用いる。このCSMA方式は、サーバ／クライアントとなる各々の端末局は送信開始に先立ち、受信状態で使用しようとする周波数チャネルの電波すなわちキャリアの他の端末局からの発射の有無を調べるキャリアセンス動作を行い、上記キャリア発射が無いことの確認後直ちにその周波数チャネルで送信を開始することにより、複数の端末局同志の送信の衝突を防止する方式である。

【0009】この種のワイヤレスLANシステムの端末局に用いる従来の無線通信装置をブロックで示す図2を参照すると、この従来の無線通信装置は、送受信に共用するアンテナや基準発信源などを含む共用部分である送受信共用部100と、供給を受けた受信信号の増幅復調を行い受信データDRを出力する受信部200と、送信データDTの供給を受け変調・周波数変換・増幅を行い所定の送信周波数の送信信号を出力する送信部300とを備える。

【0010】送受信共用部100は、送受信用に共用するアンテナ1と、アンテナ1に接続され送受信チャネル対応の所定の周波数帯域2．4～2．5GHzの信号のみ通過させるバンドパスフィルタ（BPF）2と、このBPF2をキャリアセンス時および受信時には受信部200に送信時には送信部300にそれぞれ接続するアンテナ切換回路（ASW）3と、受信部200および送信部300のそれぞれの局部発振用のシンセサイザ30，29，33に基準周波数信号FRを供給する温度補償型の水晶発振回路を含む発振回路31と、第1局部発振信号LO1を供給する電圧制御発振回路（VCO）28と、基準信号FRの供給を受けVCO21を制御するシンセサイザ30とを備える。

【0011】受信部200はダブルスーパヘテロダイン方式であり、ASW3から供給された受信信号Rを低雑音増幅するRFアンプ4と、第1局部発振信号LO1の供給を受けRFアンプ4の出力信号を第1IF信号に変換するミキサ5と、第1IF信号を増幅するIFアンプ7，9と、所定の帯域特性を有しイメージ信号などのスプリアス信号を除去するバンドパスフィルタであるSAWフィルタ8と、第2局部発振信号LO2の供給を受けIFアンプ9の出力信号を第2IF信号に変換するミキサ11と、第2IF信号を増幅するIFアンプ13，16と、所定の帯域特性を有しイメージ信号などのスプリアス信号を除去する第2IF用のバンドパスフィルタであるSAWフィルタ14と、IFアンプ16の出力信号の振幅制限を行うリミッタ17と、リミッタ17の出力信号を復調し復調信号を出力する復調回路18と、復調信号の波形整形を行い受信データDRを出力するコンパレータ19と、IFアンプ16の出力Sの供給を受けこの出力Sの振幅に対応する受信信号強度を表す信号RSを出力する受信信号強度表示回路（RSSI）20と、第2局部発振信号LO2を供給する電圧制御発振回路（VCO）21と、基準信号FRの供給を受けVCO21を制御するシンセサイザ29とを備える。

【0012】送信部300は、送信データDTの供給に応答してFSK変調された送信IF信号IFTを供給するVCO32と、基準信号FRの供給を受けVCO32を制御するシンセサイザ33と、送信IF信号IFTと第1ローカル信号との供給を受け送信IF信号IFTを所定周波数の変換信号TSに変換するミキサ25と、変換信号TSのイメージ信号などのスプリアス信号を除去するBPF26と、変換信号TSを電力増幅し送信信号Tを出力するRFパワーアンプ27とを備える。

【0013】ここで説明の便宜上、主な信号周波数について一般的な値として、各チャネルの受信／送信周波数FRT2．4～2．5GHz、チャネル間隔1MHz、第1IF周波数および送信IF周波数400MHz、第2IF周波数40MHz、第1局部発振周波数LO1（FRT－400MHz）＝2．0～2．4GHz、第2局部発振周波数LO2を360MHz、基準周波数FR10MHzとそれぞれ設定する。

【0014】図2を参照して動作について説明すると、まず、受信状態においては、アンテナ1で受信した受信信号はBPF2で希望周波数帯域2．4～2．5GHzの所定チャネル対応の周波数の受信信号Rが抽出されASW3を経由してRFアンプ4に供給され増幅される。RFアンプ4の出力信号はミキサ5に供給され、ミキサ5はこの増幅受信信号とVCO28からの2．0～2．4GHz帯の設定チャネル対応の周波数の第1局部発振信号LO1との供給を受けて400MHzの第1IF信号I1を生成する。例えば、上記設定チャネル周波数が2．45GHzとすると信号LO1の周波数は2．05GHzとなる。信号I1はIFアンプ7で増幅され、SAWフィルタ8でスプリアス信号が除去され、IFアンプ9でさらに増幅され信号I1Aとしてミキサ11に供給される。ミキサ11はこの信号I1AとVCO21からの周波数360MHzの第2局部発振信号LO2との供給を受けて40MHzの第2IF信号I2を生成する。信号I2はIFアンプ13で増幅され、SAWフィルタ14でスプリアス信号が除去され、IFアンプ16でさらに増幅され信号I2Aとしてリミッタ17に、信号SとしてRSSI20にそれぞれ供給される。リミッ

タ１７は信号ＩＺＡの供給を受けこの信号ＩＺＡの所定の振幅制限を行い生成した信号ＩＬを復調回路１８に供給する。復調回路１８は信号ＩＬを復調して復調信号をコンパレータ１９に供給する。コンパレータ１９はこの復調信号を整形してディジタルデータ信号である受信データＤＲを生成出力する。一方、ＲＳＳＩ２０は信号Ｓの供給に応答して信号Ｓの振幅すなわち受信信号強度対応の信号ＲＳを出力し、外部のコントロール系に供給する。また、この信号ＲＳは、設定チャネルにおける他の端末局の送信の有無のチェックにも使われる。

【００１５】周波数シンセサイザ３０は第１局部発振信号ＬＯ１を設定チャネルに対応した分周比で分周し約１０ＭＨｚの分周信号を生成するプリスケーラである分周回路と、この分周信号と基準周波数信号ＦＲとの位相比較を行いこの位相誤差に応答してＶＣＯ２８に対する制御信号を発生する位相同期ループ（ＰＬＬ）回路とを含む。周波数シンセサイザ３０は発振回路３１から１０ＭＨｚの基準周波数信号ＦＲの供給を受け、これを基準周波数として位相同期動作を行い設定チャネル対応の周波数の第１局部発振信号ＬＯ１を発生するようＶＣＯ２８を制御する。

【００１６】次に、送信状態においては、送信データＤＴがＶＣＯ３２に供給される。このＶＣＯ３２の発振周波数は送信ＩＦ信号ＩＦＴの周波数４００ＭＨｚであり、基準周波数信号ＦＲの周波数１０ＭＨｚを基準とする周波数シンセサイザ３３の制御信号ＰＴにより制御されている。ＶＣＯ３２は送信データＤＴの供給に応答してこの制御信号ＰＴ対応の発振周波数を送信データＤＴの符号値に対応する周波数シフトを行い、ＦＳＫ変調された送信ＩＦ信号ＩＦＴを生成する。この送信ＩＦ信号はミキサ２５に供給される。ミキサ２５は送信ＩＦ信号ＩＦＴと第１局部発振信号ＬＯ１との供給に応答して設定チャネル周波数の変換信号ＴＳに変換し、スプリアス信号除去用のＢＰＦ２６を経由してＲＦパワーアンプ２７に供給する。ＲＦパワーアンプ２７は、変換信号ＴＳを電力増幅し、送信信号Ｔを生成し、ＡＳＷ３およびＢＰＦ２を経由してアンテナ１に供給し、この送信信号Ｔを電波として送出する。

【００１７】使用するチャネルの選択は、送受信共用部１００の周波数シンセサイザ３０により、ＶＣＯ２８の発振周波数すなわち第１局部発振信号ＬＯ１の周波数を設定することにより行われる。上述のように、各々の端末局は送信開始に先立つキャリアセンス状態で選択したチャネルが空いていること、すなわち他の端末局がそのチャネルを使って送信していないことを確認する必要がある。そのため、上記チャネルに対してまず受信状態とし、ＲＳＳＩ２０の出力信号ＲＣを参照して空チャネルであることの確認後、間髪を入れずに送信状態に設定しなければならない。この時間は短かい程他の端末局との衝突防止のため良いのは当然であるが、実際のシステムでは、受信状態から送信立上げまでの所要時間として、下記の根拠から１０μｓ以下が要求される。

【００１８】上述のように、この周波数ホッピング方式のワイヤレスＬＡＮでの上記所要時間の要求値は検討中なるも、同程度のデータ伝送レートの直接拡散方式のワイヤレスＬＡＮでの上記要求値は、１９９４年１月に発行された米国のＩＥＥＥ８０２．１１委員会の文書第ＩＥＥＥ８０２．１１－９３／２３２ｒｌにて１０μｓ以下と規定されている。

【００１９】一方、ＰＬＬ回路を用いた周波数シンセサイザ３０，２９，および３３およびそれぞれ対応のＶＣＯ２８，２１，および３２との組合せによるチャネル設定対応の周波数の安定化所要時間すなわちロック時間は、以下に示す根拠により設定されるこの種の一般的なＰＬＬの内部基準周波数およびループフィルタの時定数対応の応答時間から、少なくとも数十μｓとなる。

【００２０】すなわち、上記ＰＬＬ回路のロック時間は、基準周波数信号ＦＲから分周して生成される内部基準周波数が高い程、またループフィルタの遮断周波数が高い程短くなる。この例では、２．４～２．５ＧＨｚを１ＭＨｚ間隔でチャネル設定するため、プリスケーラは６４／６５分周の２モジュラス型を用いる必要があり、クロック周波数として現在の技術の実用上の上限である５０ＭＨｚを用いても、上記内部基準周波数は５００ＫＨｚが上限である。また、上記ループフィルタの遮断周波数はキャリア・ノイズ比を考慮して最適値を設定する必要がある。

【００２１】このため、受信状態での空チャネルの確認から、そのチャネルでの送信を高速で立上げるためには、上述のように、第１局部発振信号ＬＯ１の周波数を送受信で同一、したがって受信第１ＩＦ信号ＩＦ１と送信ＩＦ信号ＩＦＴとの周波数を同一の４００ＭＨｚとするとともに、送信部３００のＶＣＯ３２は受信状態のときでも常時発振させておく必要がある。

【００２２】

【発明が解決しようとする課題】上述した従来の無線通信装置は、受信第１中間周波数と送信中間周波数とが同一であるとともに送信に先立つキャリアセンス状態における高速の送信立上げの準備のため送信中間周波信号供給用のＶＣＯは常時発振状態となっているので、上記ＶＣＯからの放射漏洩信号の受信部への干渉に起因する受信信号強度表示回路の誤動作により空の選択チャネルが使用済みとみなされ送信開始が不可能になることを防止するため、送信部と受信部相互間を厳重に遮蔽分離する構造とする必要があり、例えばクレジットカードサイズまで装置外形を小型・薄型化することは極めて困難であるという欠点があった。

【００２３】

【課題を解決するための手段】本発明の無線通信装置は、受信信号と予め定めた周波数帯域を分割した送受信

周波数が同一の複数の通信チャネルの任意の選択した１つのチャネルである選択チャネル周波数対応の第１の周波数の第１の局部発振信号との供給を受け第２の周波数の第１中間周波信号を生成する第１の受信用ミキサと、前記第１中間周波信号と第３の周波数の第２の局部発振信号との供給を受け第４の周波数の第２中間周波信号を生成する第２の受信用ミキサと、前記第１の局部発振信号を発生する第１の局部発振回路と、前記第２の局部発振信号を発生する第２の局部発振回路と、前記第１および第２の局部発振回路に供給する基準周波数信号を発生する基準周波数信号発振回路と、送信データによる所定の変調を受けた前記第２の周波数の送信中間周波信号と前記第１の局部発振信号との供給を受け前記選択チャネル周波数の送信信号を生成する第１の送信用ミキサとを備え、前記選択チャネルが他局の送信信号が存在しない空チャネルであることを送信開始前に確認して自局の送信信号を発射するキャリアセンス多重方式の無線通信装置において、非直線素子を用い送受信切替信号の送信対応の第１のレベルで動作状態に制御され前記基準周波数信号を予め定めた逓倍数で逓倍し前記第４の周波数の送信局部発振信号を発生する逓倍回路と、前記第３の周波数で発振し送信時に前記送信データの供給を受け前記変調を行い送信変調信号を生成する変調発振回路と、前記送受信切替信号の前記第１のレベルで動作状態に制御され前記送信局部発振信号と前記送信変調信号との供給を受け前記送信中間周波信号を生成する第２の送信用ミキサとを備えて構成されている。

【００２４】

【実施例】次に、本発明の実施例を図２と共通の構成要素には共通の参照文字／数字を付して同様にブロックで示す図１を参照すると、この図に示す本実施例の無線通信装置は、それぞれ従来の送受信共用部１００と、受信部２００と、送信部３００とに代り、それぞれ従来と同様の機能を有する送受信共用部１００Ａと、受信部２００Ａと、送信部３００Ａとを備える。

【００２５】送受信共用部１００Ａは、従来と共通のアンテナ１と、バンドパスフィルタ（ＢＰＦ）２と、アンテナ切換回路（ＡＳＷ）３と、発振回路３１と、電圧制御発振回路（ＶＣＯ）２８と、シンセサイザ３０とに加えて、非直線回路素子を用い送受信切替信号ＣＴの送信状態対応のレベルのとき動作し基準周波数信号ＦＲを４逓倍し４０ＭＨｚの送信局部発振信号ＬＯＴを生成する逓倍回路２４を備える。

【００２６】受信部２００Ａは、従来と共通のミキサ５，１１と、ＩＦアンプ７，９，１３，１６と、ＳＡＷフィルタ８，１４と、リミッタ１７と、復調回路１８と、コンパレータ１９と、受信信号強度表示回路（ＲＳＳＩ）２０と、シンセサイザ２９とに加えて、ＶＣＯ２１の代りに送信時に供給を受けた送信データＤＴのの符号値に対応する周波数シフトを行いＦＳＫ変調された送信局部発振信号／第２局部発振信号Ｌ２Ｔ／ＬＯ２を生成するＶＣＯ２１Ａと、送信局部発振信号／第２局部発振信号Ｌ２Ｔ／ＬＯ２を受信・送信それぞれの状態に対応して受信ＲＸ側および送信ＴＸ側に切替るスイッチ回路（ＳＷ）２２と、送受切替信号ＣＴの送信状態対応のレベルのとき動作し供給されたスプリアス信号除去されたフィルタド送信局部発振信号ＬＯＸとＳＷ２２からの第１局部発振信号ＬＯ１とから送信ＩＦ信号ＩＦＴを生成するミキサ２３と、ミキサ５とＩＦアンプ７との間に挿入され信号ＩＦＴと第１ＩＦ信号ＩＦ１とを切替てＩＦアンプ８に供給するＳＷ６と、ＩＦアンプ９とミキサ１１との間に挿入されＩＦアンプ９の出力信号をミキサ１１とミキサ２５のいずれか一方に切替て供給するＳＷ１０と、ミキサ１１とＩＦアンプ１３との間に挿入されミキサ１１からの第２ＩＦ信号と送信局部発振信号ＬＯＴとを切替て一方をＩＦアンプ１３に供給するＳＷ１２と、ＳＡＷフィルタ１４とＩＦアンプ１６との間に挿入されＳＡＷフィルタ１４の出力信号をＩＦアンプ１６とミキサ２３のいずれか一方に切替て供給するＳＷ１５とを備える。これらＳＷ２２，６，１０，１２，および１５の各々は送受信切替信号ＣＴの受信および送信状態にそれぞれ対応するＬ，Ｈののレベルに応答して切替動作を行う。

【００２７】送信部３００Ａは、従来のＶＣＯ３２と周波数シンセサイザ３３は削除され、したがって、従来と共通のミキサ２５と、ＢＰＦ２６と、ＲＦパワーアンプ２７とを備える。

【００２８】従来と同様に、主な信号周波数について、各チャネルの受信／送信周波数ＦＲＴ２．４～２．５ＧＨｚ、チャネル間隔１ＭＨｚ、第１ＩＦ周波数および送信ＩＦ周波数４００ＭＨｚ、第２ＩＦ周波数４０ＭＨｚ、第１局部発振周波数ＬＯ１（ＦＲＴ－４００ＭＨｚ）＝２．０～２．４ＧＨｚ、第２局部発振周波数ＬＯ２を３６０ＭＨｚ、基準周波数ＦＲ１０ＭＨｚとそれぞれ設定する。

【００２９】次に、図１を参照して本実施例の動作について説明すると、まず、受信状態では、送受切替信号ＣＴのＬレベルに応答してＳＷ２２，６，１０，１２，および１５の各々は受信ＲＸ側に設定される。また、ミキサ２３および逓倍回路２４は不動作状態に設定される。これらの設定状態は上述した従来の無線通信装置の受信状態の場合と同一であり、したがって、受信部各部の動作も全く同一である。しかし、逓倍回路２４およびミキサ２３が不動作状態であるため、第１ＩＦ信号ＩＦ１と同一周波数の送信ＩＦ信号ＩＦＴは存在せず、これによる受信部２００Ａに対する干渉はあり得ない。したがって、送信開始に先立つ受信状態すなわちキャリアセンス状態では、ＲＳＳＩ２０の確実な動作が可能であり、選択チャネルの空あるいは使用中に対応する受信信号強度信号ＲＳを発生する。上記選択チャネルが空である場合

には、この空チャネル対応の信号ＲＳに応答して直ちに外部コントロール系（図示省略）が送受切替信号ＣＴを送信状態対応のＨレベルに設定する。

【００３０】次に、送信状態では、送受切替信号ＣＴのＨレベルに応答してＳＷ２２，６，１０，１２，および１５の各々は送信ＴＸ側に設定される。また、ミキサ２３および逓倍回路２４は送受切替信号ＣＴのＨレベルに応答する電源のオン制御などにより動作状態に設定される。これにより、発振回路３１からの１０ＭＨｚの基準周波数信号ＦＲが逓倍回路２４で４逓倍され、４０ＭＨｚの送信局部発振信号ＬＯＴを生成する。逓倍回路２４は論理ゲート回路やステップリカバリダイオードなど非直線回路素子をパルス駆動する公知の回路で構成される。この信号ＬＯＴはＳＷ１２，ＩＦアンプ１３を経由してＳＡＷフィルタ１５に供給され、ここでスプリアス信号成分が除去されたフィルタド送信局部発振信号ＬＯＸとしてＳＷ１５を経由してミキサ２３の一方の入力に供給される。

【００３１】一方、送信データＤＴがＶＣＯ２１Ａに供給される。このＶＣＯ２１Ａの発振周波数は第２局部発振信号ＬＯ２の３６０ＭＨｚであり、基準周波数信号ＦＲの周波数１０ＭＨｚを基準とする周波数シンセサイザ２９の制御信号ＱＴにより制御されている。ＶＣＯ２１Ａは送信データＤＴの供給に応答してこの制御信号ＱＴ対応の発振周波数を送信データＤＴの符号値に対応する周波数シフトを行い、ＦＳＫ変調された送信第２局部発振信号Ｌ２Ｔを生成する。この信号Ｌ２ＴはＳＷ２２を経由してミキサ２３の他方の入力に供給される。ミキサ２３は信号ＬＯＸ，Ｌ２Ｔの供給に応答して４００ＭＨｚの送信ＩＦ信号ＩＦＴを生成し、ＳＷ６，ＩＦアンプ７を経由してＳＡＷフィルタ８に供給する。ＳＡＷフィルタ８は信号ＩＦＴのスプリアス信号成分を除去し、フィルタド送信ＩＦ信号ＩＴＸとしてＩＦアンプ９，ＳＷ１０を経由してミキサ２５の一方の入力に供給する。

【００３２】ミキサ２５はフィルタド送信ＩＦ信号ＩＴＸと第１局部発振信号ＬＯ１との供給に応答して、従来と同様に、設定チャネル周波数の変換信号ＴＳに変換し、ＢＰＦ２６を経由してＲＦパワーアンプ２７に供給する。ＲＦパワーアンプ２７は、変換信号ＴＳを電力増幅し、送信信号Ｔを生成し、ＡＳＷ３およびＢＰＦ２を経由してアンテナ１に供給し、この送信信号Ｔを電波として送出する。

【００３３】ＶＣＯ３１，２８，２１の各々は、前述のキャリアセンス／受信状態においても選択チャネル対応の周波数で常時発振状態であり、また、シンセサイザのような特別な時定数回路などを含まない逓倍回路２４，ミキサ２３の各々は電源オンなどによる動作状態設定から典型的には１μｓ以内に立上がるので、１０μｓ以下の受信／送信切替所要時間は容易に満足できる。

【００３４】上述のように、キャリアセンス／受信状態における送信系信号の受信系への干渉が原理的に存在しないため、送信系と受信系相互間の遮蔽は簡単にすることができ、両者の同一半導体チップ上への形成による高集積化も可能となる。これにより、外形の小型・薄型化が可能となり、外形寸法を例えば８５．６ｍｍ×５４ｍｍ×５ｍｍ程度のいわゆるクレジットカードサイズに納めることができる。

【００３５】以上、本発明の実施例を説明したが、本発明は上記実施例に限られることなく種々の変形が可能である。例えば、送信信号のスプリアス成分除去のため受信部のＳＡＷフィルタを用いる代りに独立のバンドパスフィルタを用い、関連するスイッチ回路を削除することも本発明の主旨を逸脱しない限り適用できることは勿論である。

【００３６】

【発明の効果】以上説明したように、本発明の無線通信装置は、送信時に動作状態に制御され非直線素子を用い送信局部発振信号を発生する逓倍回路と、第２局部発振周波数の変調発振回路と、送信時に動作状態に制御され送信局部発振信号と送信変調信号とから送信中間周波信号を生成する第２の送信用ミキサとを備えることにより、キャリアセンス／受信状態における送信系信号の受信系への干渉が原理的に存在しないため、送信系と受信系相互間の遮蔽は簡単にすることができ、両者の同一半導体チップ上への形成による高集積化も可能となることにより、キャリアセンス状態から高速な送信立上げを確保しつつ例えばクレジットカードサイズまでに外形の小型・薄型化が可能となるという効果がある。

【図面の簡単な説明】

【図１】本発明の無線通信装置の一実施例を示すブロック図である。

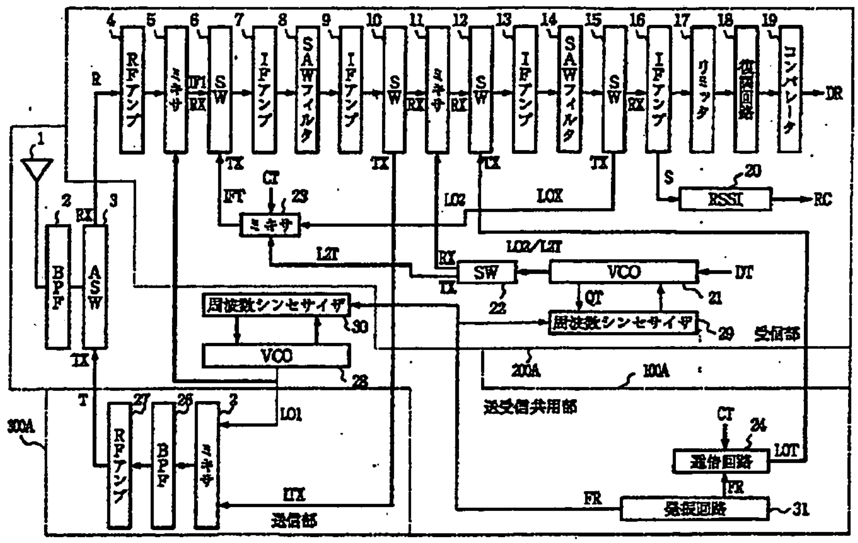
【図２】従来の無線通信装置の一例を示すブロック図である。

【符号の説明】

１　アンテナ
２，２６　ＢＰＦ
３　ＡＳＷ
４　ＲＦアンプ
５，１１，２３，２５　ミキサ
６，１０，１２，１５，２２　ＳＷ
７，９，１３，１６　ＩＦアンプ
８，１４　ＳＡＷフィルタ
１７　リミッタ
１８　復調回路
１９　コンパレータ
２０　ＲＳＳＩ
２１，２８，３２，２１Ａ　ＶＣＯ
２７　ＲＦパワーアンプ
２９，３０，３３　周波数シンセサイザ
３０　周波数シンセサイザ

３１　発振回路
１００，１００Ａ　送受信共用部
２００，２００Ａ　受信部
３００，３００Ａ　送信部

【図１】



【図２】